An Adaptive Approach to Treat Chlorinated Ethenes in Fractured Bedrock at a Redevelopment Site

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Background/Objectives. A former dry cleaner facility and surrounding properties in River Edge, New Jersey were being redeveloped into a retail mall. Discharge of perchloroethylene (PCE) wastes directly onto the ground surface resulted in two source areas at the site. Source materials was removed in early 2000s, but the concentrations of PCE and daughter products remained significantly above the NJDEP Ground Water Quality Standards (GWQS) in the bedrock aquifer. The complex sub-surface geology consists of unconsolidated silt, sand and clay as the overburden unit underlain by weathered and fractured rock. Concentration of PCE in source area monitoring wells ranged from 5,000 to 25,000 µg/L. Remedial objectives were to decrease the concentrations of chlorinated ethenes (CEs) in source area wells within 5 years to a point where the site could be transitioned to monitored natural attenuation.

Approach/Activities. Remediation strategy was driven by the redevelopment aspects of the site with a realization that there would be limited to no future access at the site for continued treatment. The conceptual site model indicated that the geochemical conditions in the targeted treatment zone supported an in situ chemical reduction (ISCR) approach. ISCR would also provide both short and long-term treatment which was a key consideration. A remediation plan around EHC®, an ISCR amendment that combines the synergistic effects of zero valent iron (ZVI) and fibrous organic carbon for treatment of CE was developed and approved. A total of seventeen injection points were installed in the two source areas based on an estimated radius of influence (ROI) of 25 ft. EHC was injected by creating 175 fractures using pneumatic emplacement technology in March 2012. Performance monitoring conducted for 5 years showed order of magnitude reductions in CE in key source area wells except one well. In 2017, a modified ISCR approach which incorporated an additional biogeochemical pathway was proposed to treat residual concentrations, and target well MW-13A. Initial results from the second application show further reductions in CE concentrations.

Results/Lessons Learned. Pneumatic emplacement was very effective in achieving a ROI of approximately 25 feet. Rapid reduction of PCE accompanied by temporal fluctuations of degradation products TCE, DCE and VC was observed. Complete reduction of PCE to below 1 ug/L was noted at several key well locations. However, after 5 years due to diminishing electron donor and continued back diffusion from the rock, CE concentrations in one source area well (MW-13A) remained elevated. A strategy was developed to target this source area based on lessons learned. The overall approach was still ISCR but the chemistry and formulation was altered slightly to get better performance. Results from the second phase of this remediation will be presented.